

Back Testing User Guide



INTRODUCTION

The function of backtesting is to test a trading strategy on historical data to see if it could work for future trades, to evaluate its profitability before risking any money.

This document contains the basics of creating a backtest. All backtests are done in a similar way to this document.

There are two ways to create a backtest using the prorealtime charting within Marketmaker, either by using the assisted creation or by programming.

Advantages

- Saving time and money on strategies that don't work
- Optimizing strategies
- Creating winning strategies will make money

Disadvantages

- Previous trends may not be a representation of the future trends particularly when markets turn sharply e.g. 'dotcom' boom in 2000
- Marketmaker does not allow program trading
- Capital management does not consider margin trading
- Chart data is only bid based so it doesn't take into account costs of spread, although commission can be included to represent this
- Costs of rollovers for cash or spot instruments and the cost of carry model for futures is also not represented.

WARNING

The strategies provided in this document are only given to help you understand the use of advanced technical analysis and not suggesting that you try any of these strategies for yourself as they may or may not be profitable.

You may need to modify or optimize these strategies in addition to adjusting the capital management conditions to suit your criteria.

ASSISTED CREATION

This section covers creating a backtest using the assisted creation, which helps us create a backtest using wizards.

Example

Lets create a RSI (relative strength index) indicator on the UK100 cash chart.

- Right click UK100 cash in the tree or a single/group price window to display the chart and change the time frame to 1 year/daily on the toolbar
- Then click add indicator, under the indicator tab a single click left on RSI will give us a description on the right about the indicator and how its calculated but you need to double click on RSI to create the indicator
- Click close on the properties window that appears we will use the standard defaults

You will now have a chart with an indicator as seen in figure 1 below.



Figure 1: UK100 chart with an RSI indicator

The Three Stages to a Backtest

1. Order Definition

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest

Here you are presented with two options either to create a backtest using the assisted creation or by programming.

- Click on the assisted creation tab as seen below in figure 2

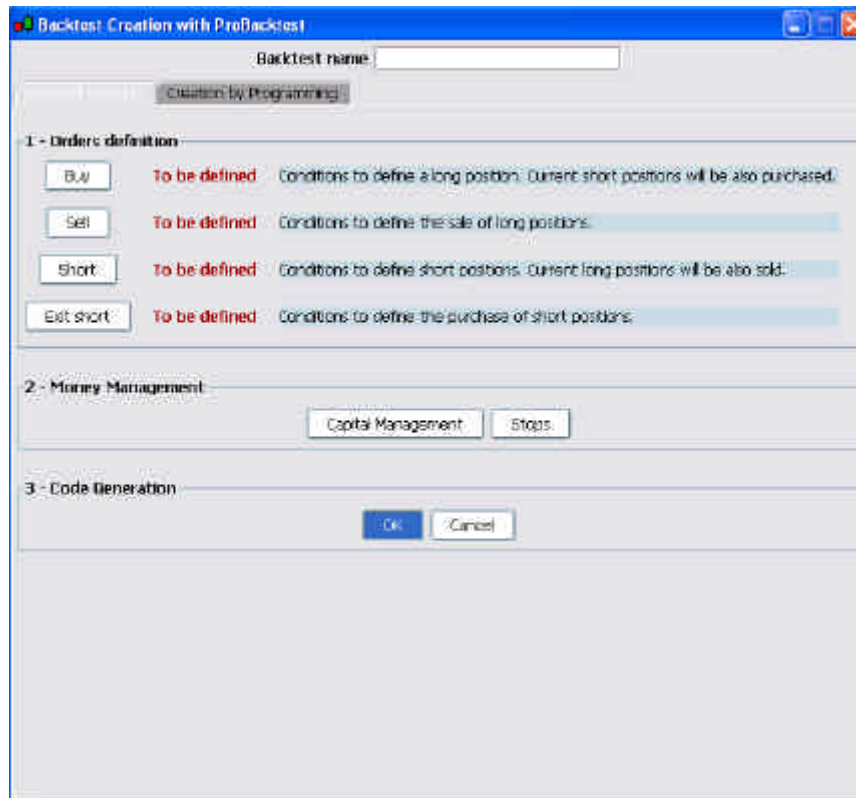


Figure 2: options to create a backtest

For simplicity in this example we will use the assisted creation. We will create a long strategy to buy when the RSI is \leq (below or equal to) 35 and sell the position once RSI is \geq (above or equal to) 65.

- To enter the condition to go long click on buy, the assisted creation will prompt you to click on the chart as seen in figure 3

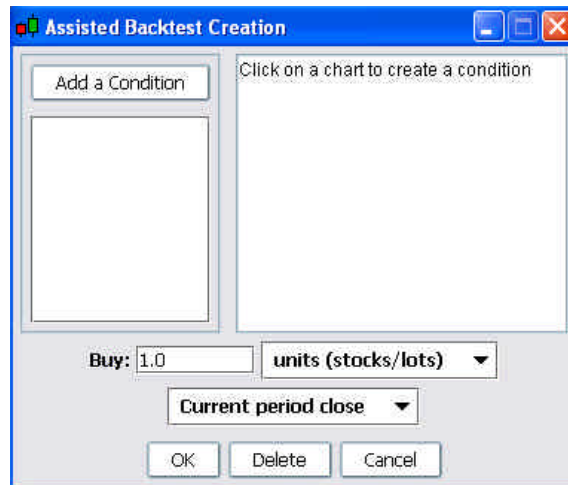


Figure 3: defining an order in assisted creation

- Click on the RSI indicator on the chart as we are defining conditions related to this
- Then define the conditions so that we buy when RSI is \leq to a value of 35 with a quantity of 100 000 then click OK, as shown in figure 4 below

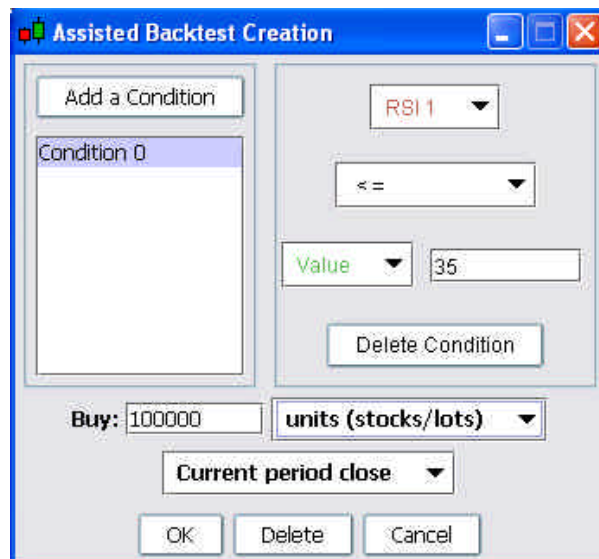


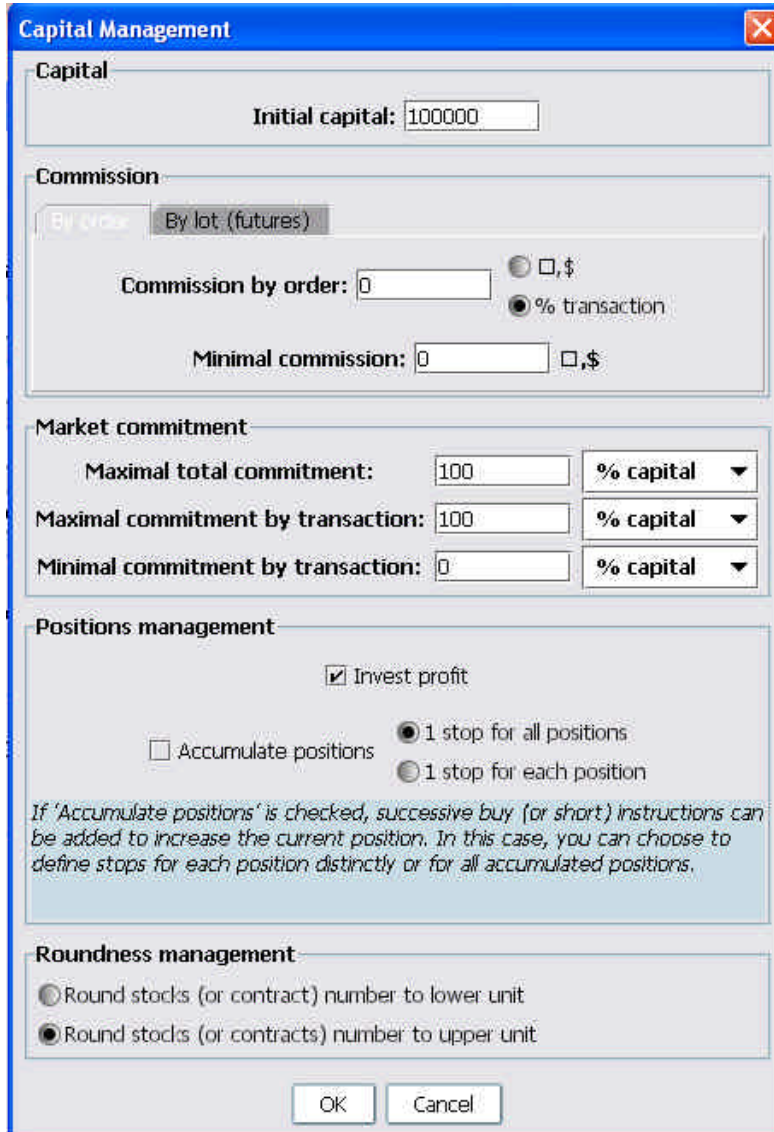
Figure 4: a defined order condition to enter a long position

- Click on the sell and define the RSI to be \geq value of 65 and OK the box

Tip: if you make a mistake just click on the order definition again shown in figure 2.

2. Money Management

- Click on the capital management button (as seen in section 2 of figure 2) and the screen shown in figure 5 will open. Our initial capital of 100 000 should already be defined. In this case set the commission by order and the minimum commission to 0 then click OK to close the window. For this example leave everything else the same as we want to invest all our money on a compound basis
- We wont define any stops for this example



Capital Management

Capital

Initial capital: 100000

Commission

By order By lot (futures)

Commission by order: 0 ☐ \$ ☒ % transaction

Minimal commission: 0 ☐ \$

Market commitment

Maximal total commitment: 100 % capital ▼

Maximal commitment by transaction: 100 % capital ▼

Minimal commitment by transaction: 0 % capital ▼

Positions management

☒ Invest profit

☐ Accumulate positions ☒ 1 stop for all positions ☐ 1 stop for each position

If 'Accumulate positions' is checked, successive buy (or short) instructions can be added to increase the current position. In this case, you can choose to define stops for each position distinctly or for all accumulated positions.

Roundness management

☐ Round stocks (or contract) number to lower unit

☒ Round stocks (or contracts) number to upper unit

OK Cancel

Figure 5: configuring capital management

3. Code Generation

- Press ok to create the program. The program is created as seen in figure 6.

This line is a note to yourself, you can write anything after REM and it will be ignored



Figure 6: the assisted creation generates our code

- Enter a name for this backtest, its best to tick the box to keep the window open at the bottom, before validating the program

Tip: you always need to enter a name for the backtest else it will produce an error stating to enter a name.

A detailed reported will be produced with 3 tabs as displayed below in figure 7. The below default statistics tab shows the overall strategy produced 2 trades of which both were profitable.

Detailed Report: RSI example

	All Trades	Long Trades	Short Trades
Total Net Profit	9131.00	9131.00	0.00
Gross Profit	9131.00	9131.00	0.00
Gross Loss	0.00	0.00	0.00
Profit Factor	n/a	n/a	n/a
Total Number of Trades	2	2	0
Percent Profitable	100.00%	100.00%	n/a
Winning Trades	2	2	0
Losing Trades	0	0	0
Even Trades	0	0	0
Avg Trade Net Profit	4565.50	4565.50	n/a
Avg Winning Trade	4565.50	4565.50	n/a
Avg Losing Trade	n/a	n/a	n/a
Std Deviation of Trade Profit	165.50	165.50	n/a
Largest Winning Trade	4731.00	4731.00	0.00
Largest Losing Trade	0.00	0.00	0.00
Avg Bars in Trades	33.50	33.50	n/a
Avg Bars Between Trades	262.00	262.00	n/a
Avg Bars in Winning Trades	33.50	33.50	n/a
Avg Bars in Losing Trades	n/a	n/a	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	20.36%	20.36%	20.36%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	0	0	0
Max Consecutive Losing Trades	0	0	0
Max draw down	3135.00	3135.00	0.00
Max equity run up	10491.00	10491.00	0.00
Return on Initial Capital	9.13%	9.13%	0.00%

Modify Backtest Close

Figure 7: detailed report of our backtest showing the overall statistics

Note: The return on capital will not be displayed correctly due to margin trading not being taken into account. However the net profit will continue to change real time if positions are open.

The orders list tab displayed in figure 8 shows our 4 trades being entered with our total equity changing as we enter and exit trades.

Although we are investing 100 000 and using 100% of capital on our trades the system only buys 20 as $100\,000 / 4826 = 20$ which is equal to 20usd/pt (as the system is in US Dollars). The current value just refers to the quantity times the price, e.g. $4826 \times 20 = 96520$ which is the contract value.

Alternatively we can view this 9+% return as 900+% because we only have to use 1% as margin on indices at CMC Markets, based upon investing all our capital.

Detailed Report: RSI example

Statistics **Orders list** Trades list

Date	↑	Buy/Sell	Price	Qty	Current Value	Commission
18 Nov 2005		Sell (Exit)	5503	19	104557	-
13 Oct 2005		Buy (Enter)	5254	19	99826	-
14 Jun 2005		Sell (Exit)	5046	20	100920	-
18 Apr 2005		Buy (Enter)	4826	20	96520	-

Modify Backtest Close

Figure 8: orders placed in our backtest

The trades list tab in figure 9 below shows our 2 trades and their direction.

Dettaglio Report: RSI example

Statistics: Orders list

Entry Date	Exit Date	Type	Days Win	Abs Profit	Real Profit	Commission
13 Oct 2005	18 Nov 2005	Long	35	4731	5	-
18 Apr 2005	24 Jun 2005	Long	41	4400	5	-

Modify Backtest Close

Figure 9: the 2 trades and their direction

The chart below in figure 10 shows our backtest results, which can be saved using the paintbrush icon.

This part of the chart shows our total equity changing with time when holding the position, flat lines indicating that no positions are being held

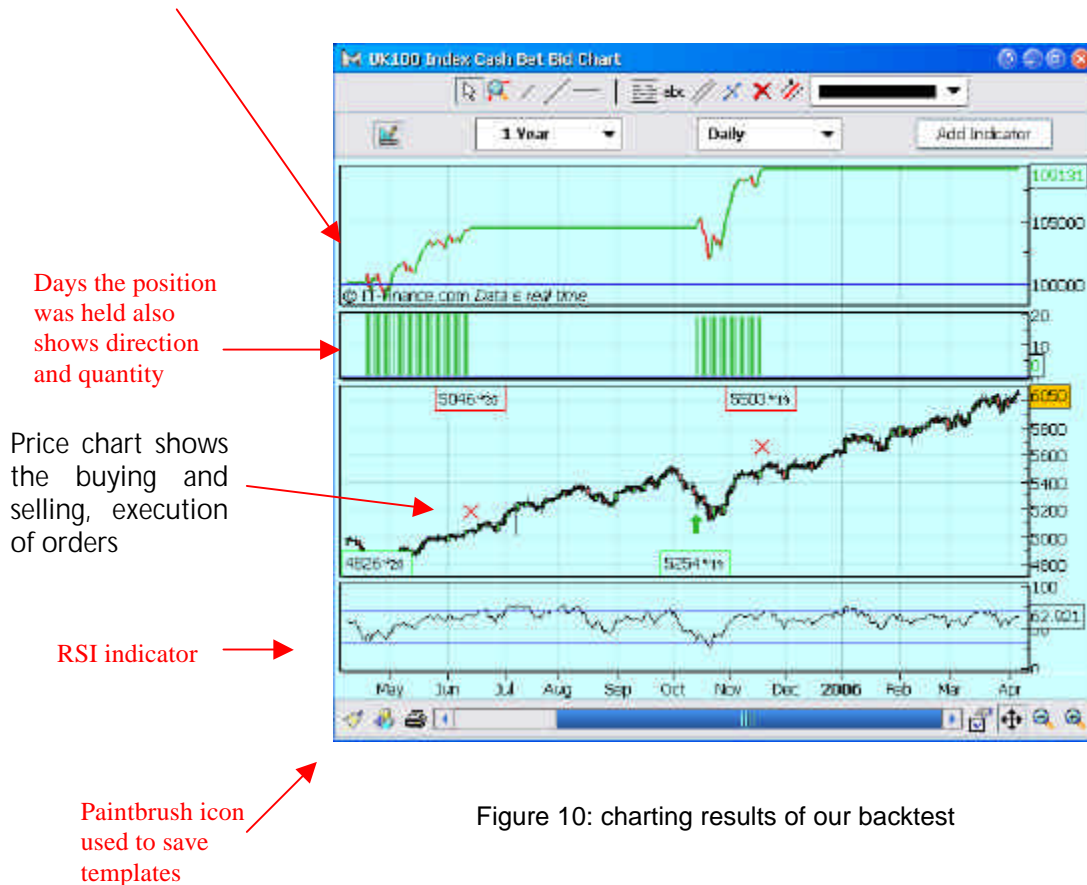


Figure 10: charting results of our backtest

... the values you get for your backtest maybe different unless you use the same start and end dates. This is because the first and last date is used as the standard default. We will see later how this can be changed.

Tip: To read the chart more clearly, you tick the value boxes under the chart options in the options menu in Marketmaker as seen in figure 11. Then whichever chart you look at as in figure 12 the value box is displayed providing more detailed information as the chart is read for you.

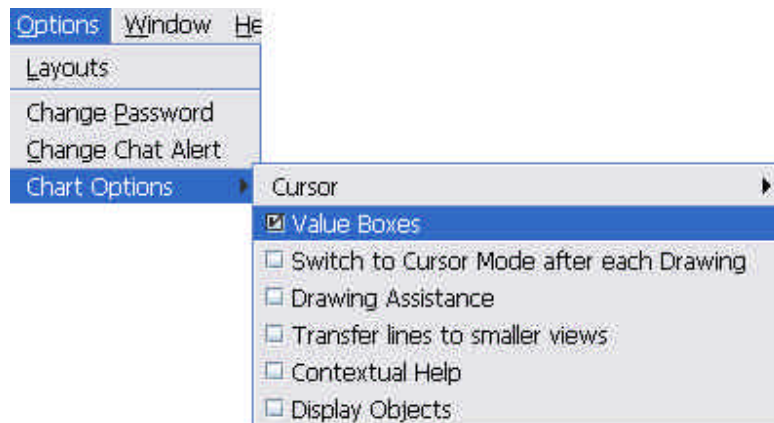


Figure 11: how to enable value boxes in Marketmaker



Figure 12: an example of a value box of USDJPY on 20 Mar 06

Creating a Short Position on a Backtest

Order Definition

You can also enter shorts in the order definition of the assisted creation where you must define the exit of the short to close the position.

Once you have your chart with your indicator:

- Click add indicator then click on the backtest tab, create backtest
- Click on assisted creation tab
- To enter the condition to go short click on short, the assisted creation will prompt you to click on the chart
- Define your shorting criteria and click ok
- Then click on exit short and as above define your criteria from the chart

Advanced – Refining your Backtest

Capital Management

Below is a breakdown of what the capital management window shown in figure 11 represents.

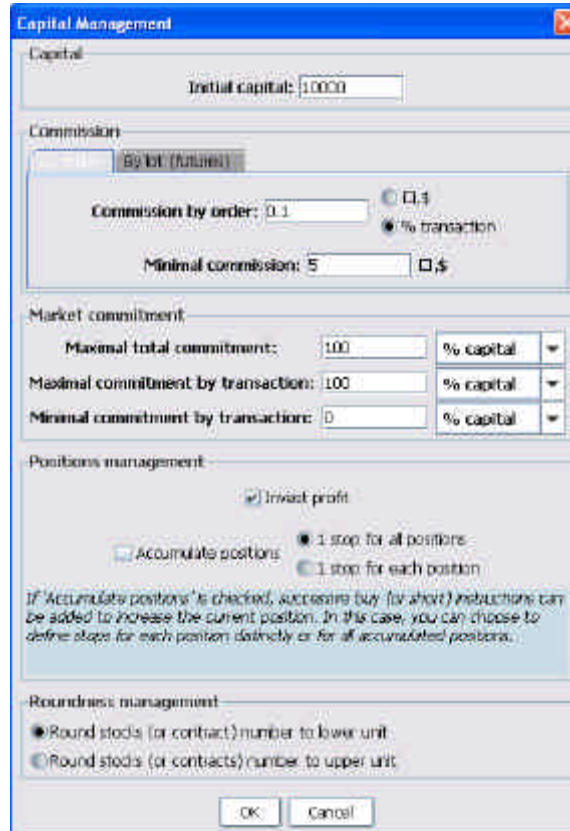


Figure 11: the capital management window

Initial Capital

You can define the initial capital from one of two ways. Either via the capital management under the capital section or when defining order definitions i.e. like in the first example when entering a buy condition or entering a short condition.

As previously stated it does not create margin trading hence for example if you decided to invest 100 000 on GBPUSD at a price of 1.8000 this will give you a position of 55 555. However with an FX account, margin is 1% so you could effectively buy 10 000 000. As another example if you wanted to buy 100 000 worth of BP (UK) stock at 625 that would be 156 (both rounded down) but really at 3% margin you could buy 5333. The initial capital is in USD but here we are only concerned with the quantities. Hence you need to adjust the initial capital to reflect your gearing or calculate the returns yourself by multiplying the factor of leverage.

Commission

This can only be defined by order and not by lot as suggested.

Commission by order can be either set per fixed amount per transaction or by percentage only in dollars. A minimum can also be set. This will take into account both sides of the trade i.e. on opening and closing.

Market Commitment

The amount of money you wish to allocate to any trade can be set either as a percentage of capital or cash or a fixed US dollar cash amount; with a maximum and minimum commitment per transaction.

Positions Management

You can choose to invest any profit that is accumulated by ticking the box 'invest profit'.

By ticking accumulate positions when the criteria for your entrance on long/short position is reached the backtest will effectively add to your position.

The stops on accumulative positions can be the same for the entire position or for each position, simply tick the appropriate box.

Roundness Management

When entering positions you can either round the number of shares up or down, as fractions cannot be bought/sold; again define the criteria with the appropriate box.

Stops

When defining stops using the assisted creation there are four choices as in Figure 12.

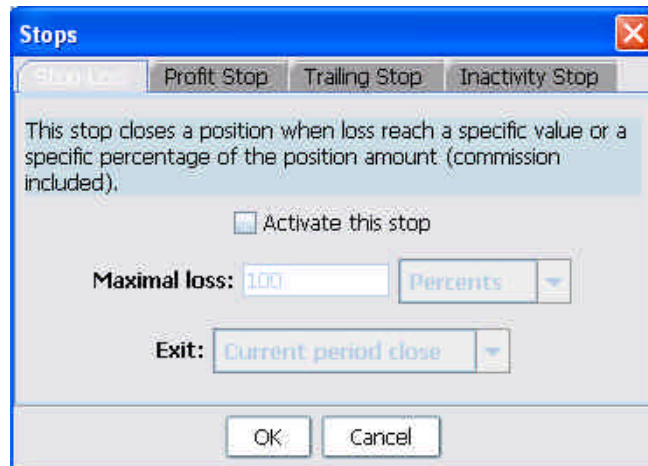


Figure 12: shows the different types of stops that can be used

Stop loss

This stop closes a position when a loss reaches a specific value or a specific percentage of the position amount including commission

- Tick activate this stop and choose the percentage or points for execution including on which bar to activate

Profit Stop

This stop closes a position when a profit reaches a specific value or percentage commission included

- Tick activate this stop and choose the percentage or points for activation along with when

Trailing stop

This stops closes a position when a specific value or percentage of profit was lost compared to the maximum potential profit reached since the beginning of the position (commission included).

- Tick activate this stop and choose the percentage or points for profit decrease along with when

Inactivity Stop

This stop closes a position if for a given period, price did not move in a profitable way of a given percentage.

- Tick activate this stop and choose the percentage or points for activation along with when and include the period

Test Yourself

Try to create a US30 chart displayed for one year based on a daily time frame, with an MACD indicator not the simplified MACD.

Conditions for long positions

For our backtest we want to create only long positions, so that we buy when MACD 1 (blue line) crosses under signal 1 (red line) and sell when MACD 1 crosses over signal 1.

Conditions for capital management

Enter the initial capital as 100 000 where we reinvest all the profits with no commissions on our trades; we don't want any stops either.

(Turn the page if you struggle)

Lets create a MACD indicator on the US30 cash chart.

- Right click US30 cash in the tree or a single/group price window to display the chart and change the time frame to 1 year/daily on the toolbar
- Then click add indicator and double click on MACD on the left under the indicator tab
- Click close on the properties window that appears we will use the standard defaults

You will now have a chart with an indicator like figure 13 seen below.

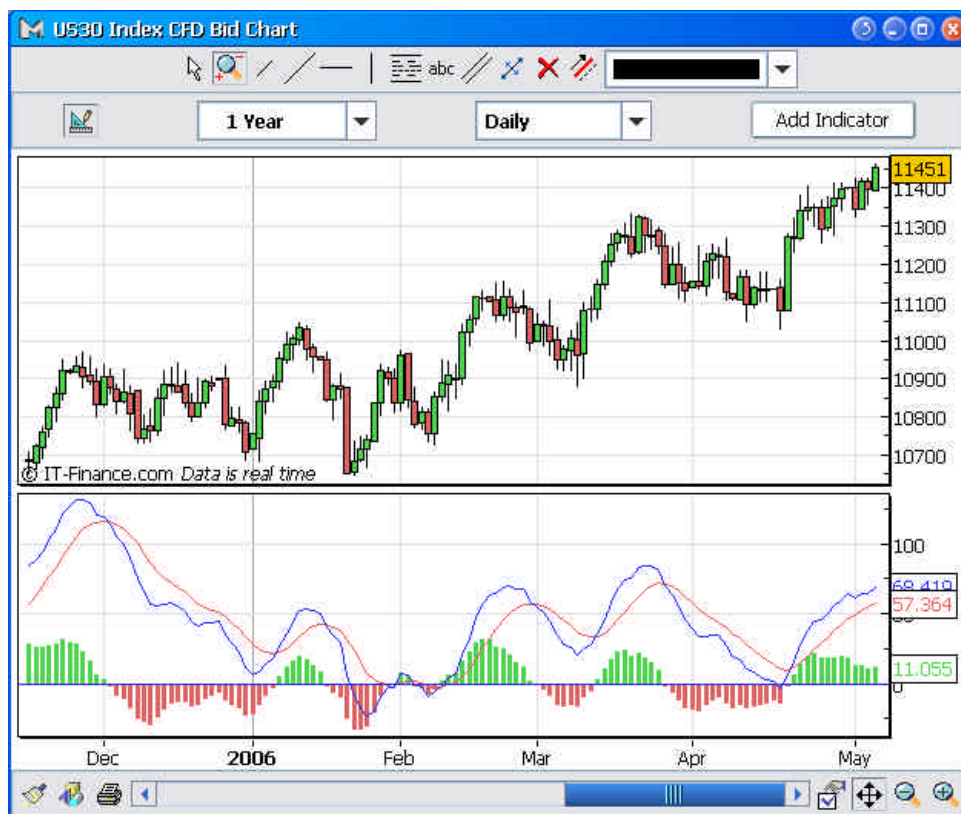
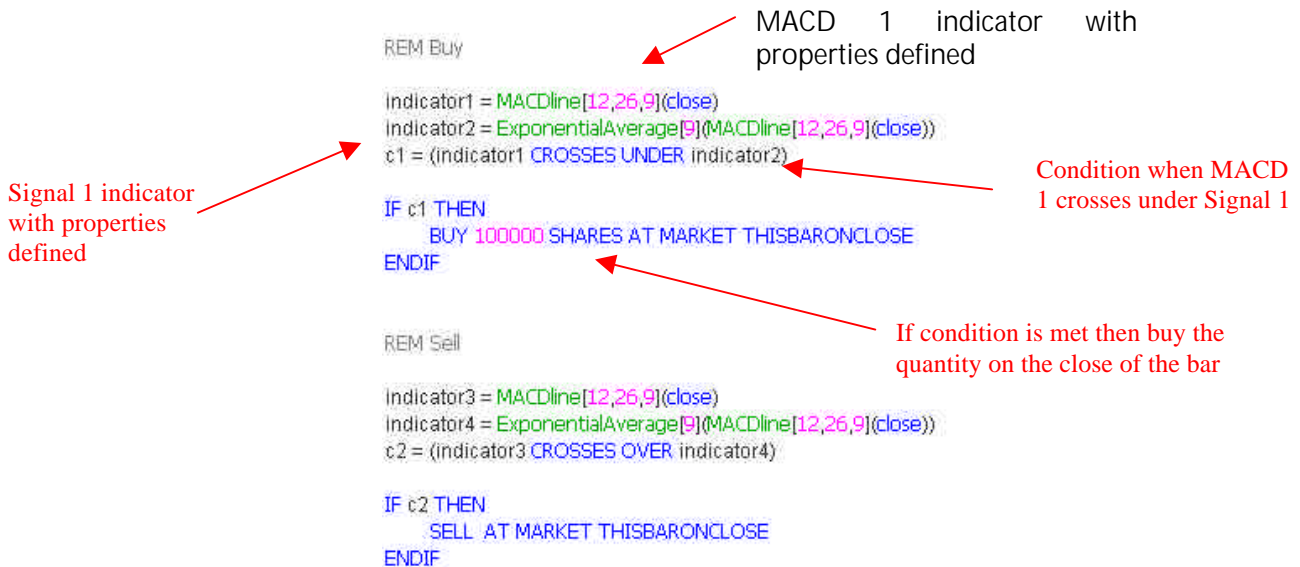


Figure 13: US30 chart with an MACD indicator

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest
- Click on the assisted creation tab
- Click on buy and then MACD on the chart
- Then define the conditions so that we buy when MACD 1 (blue line) crosses under signal 1 (red line) with a quantity of 100 000 then click OK
- Click on the sell for the condition when MACD 1 crosses over signal 1

- Click on the capital management button. Our initial capital of 100 000 should already be defined. In this case set the commission by order and the minimum commission to 0.
- Press ok to create the program

Figure 14 shows the program that is produced.



```

REM Buy
Indicator1 = MACDline[12,26,9](close)
Indicator2 = ExponentialAverage[9](MACDline[12,26,9](close))
c1 = (Indicator1 CROSSES UNDER Indicator2)
IF c1 THEN
    BUY 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF

REM Sell
Indicator3 = MACDline[12,26,9](close)
Indicator4 = ExponentialAverage[9](MACDline[12,26,9](close))
c2 = (Indicator3 CROSSES OVER Indicator4)
IF c2 THEN
    SELL AT MARKET THISBARONCLOSE
ENDIF
    
```

MACD 1 indicator with properties defined

Signal 1 indicator with properties defined

Condition when MACD 1 crosses under Signal 1

If condition is met then buy the quantity on the close of the bar

Figure 14: shows the program generated

- Enter a name for this backtest and then validate the program

Figures 15-18 display the detailed results and chart produced. In this case it seems that this may have been a good trading strategy with 78% profitable trades, remember percentage return doesn't include gearing.

	All Trades	Long Trades	Short Trades
Total Net Profit	7299.00	7299.00	0.00
Gross Profit	10611.00	10611.00	0.00
Gross Loss	-3312.00	-3312.00	0.00
Profit Factor	3.20	3.20	n/a
Total Number of Trades	14	14	0
Percent Profitable	78.57%	78.57%	n/a
Winning Trades	11	11	0
Losing Trades	3	3	0
Even Trades	0	0	0
Avg Trade Net Profit	521.36	521.36	n/a
Avg Winning Trade	964.64	964.64	n/a
Avg Losing Trade	-1104.00	-1104.00	n/a
Std Deviation of Trade Profit	1065.12	1065.12	n/a
Largest Winning Trade	2061.00	2061.00	0.00
Largest Losing Trade	-2745.00	-2745.00	0.00
Avg Bars in Trades	11.71	11.71	n/a
Avg Bars Between Trades	14.92	14.92	n/a
Avg Bars in Winning Trades	10.00	10.00	n/a
Avg Bars in Losing Trades	18.00	18.00	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	45.81%	45.81%	45.81%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	3	3	0
Max Consecutive Losing Trades	2	2	0
Max draw down	-4599.00	-4599.00	0.00
Max equity run up	9837.00	9837.00	0.00
Return on Initial Capital	7.30%	7.30%	0.00%

Figure 15: detailed statistics report from the backtest

Detailed Report: MACD-US30

Statistics **Trades List**

Date	Buy/Sell	Price	Qty	Current Value	Commission
19 Apr 2006	Sell (Exit)	11269	9	101421	+
28 Mar 2006	Buy (Enter)	11146	9	100314	+
14 Mar 2006	Sell (Exit)	11146	9	100314	+
1 Mar 2006	Buy (Enter)	11042	9	99379	+
9 Feb 2006	Sell (Exit)	10880	9	97974	+
9 Feb 2006	Buy (Enter)	10780	9	97020	+
1 Feb 2006	Sell (Exit)	10961	9	98649	+
17 Jan 2006	Buy (Enter)	10844	9	97596	+
6 Jan 2006	Sell (Exit)	10932	9	98508	+
2 Dec 2005	Buy (Enter)	10875	9	97975	+
19 Oct 2005	Sell (Exit)	10420	9	93780	+
4 Oct 2005	Buy (Enter)	10415	9	93735	+
30 Sep 2005	Sell (Exit)	10579	9	95211	+
20 Sep 2005	Buy (Enter)	10473	9	94257	+
6 Sep 2005	Sell (Exit)	10589	9	95265	+
4 Aug 2005	Buy (Enter)	10608	9	95472	+
11 Jul 2005	Sell (Exit)	10513	9	94617	+
23 Jun 2005	Buy (Enter)	10412	9	93708	+
15 Jun 2005	Sell (Exit)	10563	9	95067	+
7 Jun 2005	Buy (Enter)	10492	9	94428	+
29 Apr 2005	Sell (Exit)	10107	9	91693	+
28 Apr 2005	Buy (Enter)	10047	9	90423	+
27 Apr 2005	Sell (Exit)	10184	9	91656	+
14 Apr 2005	Buy (Enter)	10224	9	92016	+
7 Apr 2005	Sell (Exit)	10546	9	94914	+
10 Mar 2005	Buy (Enter)	10851	9	97659	+
25 Feb 2005	Sell (Exit)	10836	9	97524	+
22 Feb 2005	Buy (Enter)	10607	9	95451	+

Modify Backtest Close

Figure 16: the 28 orders for this backtest

Detailed Report: MACD-US30

Statistics Order Id:

Entry Date	↑	Exit Date	Type	Bars Fld	Abs Prof	Relat Prof	Commission
28 Mar 2006		19 Apr 2006	Long	19	1107	1	-
1 Mar 2006		14 Mar 2006	Long	9	935	1	-
3 Feb 2006		9 Feb 2006	Long	4	854	1	-
17 Jan 2006		1 Feb 2006	Long	11	1053	1	-
2 Dec 2005		6 Jan 2006	Long	25	893	1	-
4 Oct 2005		19 Oct 2005	Long	12	45	0	-
20 Sep 2005		30 Sep 2005	Long	11	854	1	-
4 Aug 2005		6 Sep 2005	Long	24	-207	-0	-
23 Jun 2005		13 Jul 2005	Long	12	909	1	-
7 Jun 2005		15 Jun 2005	Long	6	629	1	-
26 Apr 2005		29 Apr 2005	Long	1	1260	1	-
14 Apr 2005		27 Apr 2005	Long	9	-360	-0	-
10 Mar 2005		7 Apr 2005	Long	23	-2745	-9	-
22 Feb 2005		25 Feb 2005	Long	3	2061	2	-

Modify Backtest Close

Figure 17: the 14 trades created by our backtest showing direction

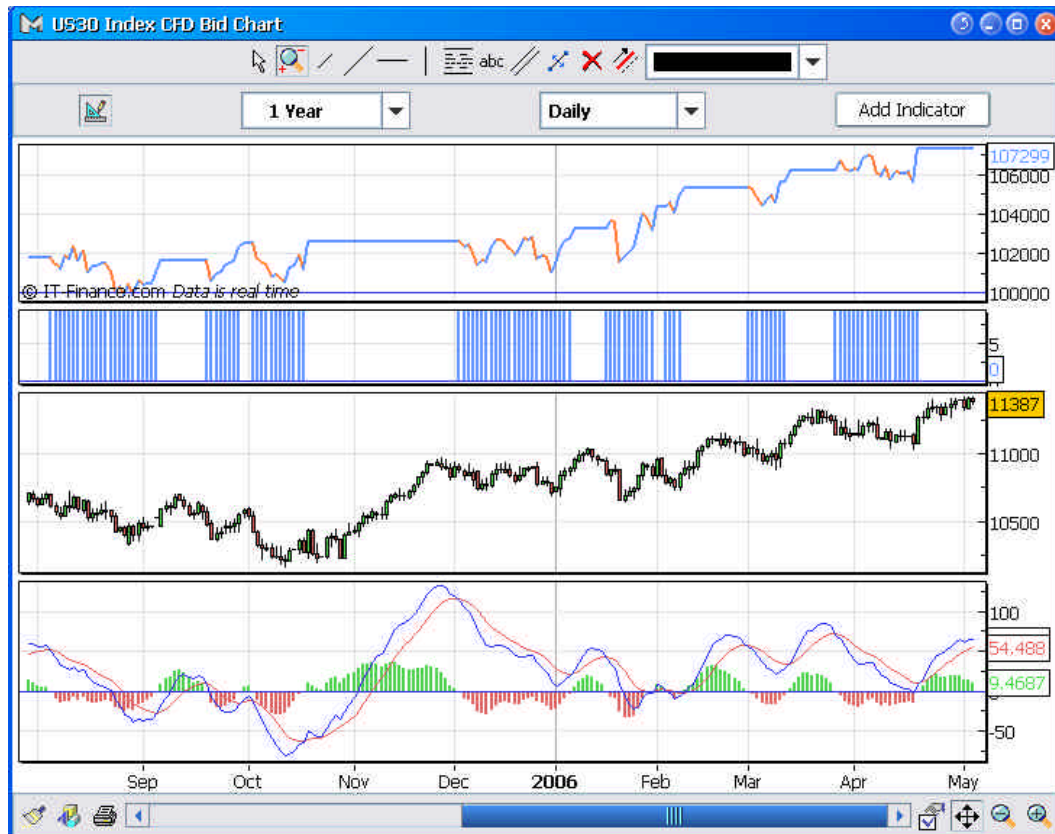


Figure 18: the graphical representation of our backtest

Optimization

You can optimize your backtest to try and produce greater profits by redefining parameters so that system can calculate what the best parameter will be for optimum results.

It will be easier to understand with an example.

Create a GBPUSD spot chart and add a CMO (chandle momentum indicator) leaving the default properties.

We are looking at the decline taking place between 10 Mar 05 to 30 Nov 05 as seen in figure 19. We will be shorting when CMO is ≥ 37 and closing our short when CMO is ≤ -37 .

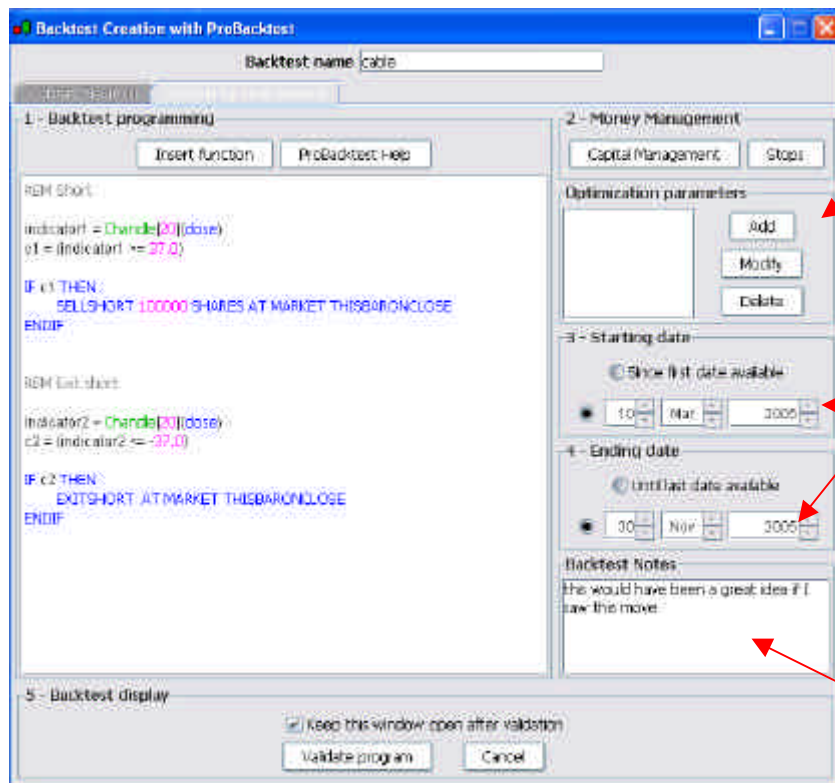
We will then optimize this strategy so that our entrance price is at its optimum, and see what changes if any take place with our return on capital.



Figure 19: GBPUSD chart with a CMO indicator

- To create the backtest on this chart simply click add indicator then click on the backtest tab, create backtest using the assisted creation

- Click on short and then CMO on the chart
- Define the conditions to short 100 000 when Chande 1 is \geq to a value of 37
- Click on the exit short for the condition when Chande 1 is \leq to a value of -37
- Check that the commission by order and the minimum commission is 0 under capital management and that the initial capital is correct
- Press ok to create the program and enter a name
- Enter the starting and ending date in section 3 and 4 as shown in figure 20
- Tick the box 'keep this window open after validation' and validate the program



Backtest name: cable

1 - Backtest programming

Insert function ProBacktest Help

```

REM Short
Indicator1 = Chande(30)(close)
c1 = (Indicator1 >= 37.0)

IF c1 THEN
  SELLSHORT 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF

REM Exit short
Indicator2 = Chande(30)(close)
c2 = (Indicator2 <= -37.0)

IF c2 THEN
  EXITSHORT AT MARKET THISBARONCLOSE
ENDIF
  
```

2 - Money Management

Capital Management Stops

Optimization parameters

Add Modify Delete

3 - Starting date

Since first date available

10 Mar 2000

4 - Ending date

until last date available

30 Nov 2000

Backtest Notes

He would have been a great idea if I saw this move

5 - Backtest display

☒ Keep this window open after validation

Validate program Cancel

We will optimize our program using different parameters from here

You can enter dates here using the arrow and numeric buttons

You can make notes to your self in this section as done here

Figure 20: program for our backtest with defined properties

Figures 21-24 show the results that are produced

Detailed Report: cable

Orders list | Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	2497.23	0.00	2497.23
Gross Profit	2497.23	0.00	2497.23
Gross Loss	0.00	0.00	0.00
Profit Factor	n/a	n/a	n/a
Total Number of Trades	4	0	4
Percent Profitable	75.00%	n/a	75.00%
Winning Trades	3	0	3
Losing Trades	0	0	0
Even Trades	1	0	1
Avg Trade Net Profit	1974.91	n/a	1974.91
Avg Winning Trade	2499.09	n/a	2499.09
Avg Losing Trade	n/a	n/a	n/a
Std Deviation of Trade Profit	1277.05	n/a	1277.05
Largest Winning Trade	3109.89	0.00	3109.89
Largest Losing Trade	0.00	0.00	0.00
Avg Bars in Trades	18.00	n/a	18.00
Avg Bars Between Trades	52.00	n/a	52.00
Avg Bars in Winning Trades	24.00	n/a	24.00
Avg Bars in Losing Trades	n/a	n/a	n/a
Avg Bars in Even Trades	0.00	n/a	0.00
Percent of Time in the Market	31.58%	31.58%	31.58%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	0	0	0
Max Consecutive Losing Trades	0	0	0
Max draw down	3413.49	0.00	3413.49
Max equity run up	2559.52	0.00	2559.52
Return on initial capital	7.50%	0.00%	7.50%

Modify Backtest | Close

Figure 21: detailed statistics report

Detailed Report: cable

Statistics **Trades list**

Date	T	Buy/Sell	Price	Qty	Current Value	Commission
4 May 2006		Sell (Enter)	1.8514	58062	107495.9844	-
4 May 2006		Buy (Exit)	1.8514	58062	107495.9844	-
25 Sep 2005		Buy (Exit)	1.7790	58057	104706.0625	-
10 Aug 2005		Sell (Enter)	1.7966	58057	106101.8047	-
12 May 2005		Buy (Exit)	1.8628	53745	100116.1875	-
20 Apr 2005		Sell (Enter)	1.9385	53745	103109.7812	-
26 Mar 2005		Buy (Exit)	1.8662	53918	96589.3672	-
11 Mar 2005		Sell (Enter)	1.9261	53918	99599.2578	-

Modify Backtest Close

Figure 22: orders list for the backtest

Statistics: Orders list

Entry Date:	Exit Date:	Type:	Bars No:	Abs. Prof:	Relat. Prof:	Commission:
4 May 2006	4 May 2006	Short	0	-	-	-
10 Aug 2005	25 Sep 2005	Short	30	1303.7422	-1.3311	-
30 Apr 2005	12 May 2005	Short	10	2003.5098	-2.0001	-
11 Mar 2005	28 Mar 2005	Short	14	3109.8906	-3.2097	-

Modify Backtest Close

Figure 23: the four trades with their direction



Figure 24: GBPUSD chart with backtest results

- If you click on 'modify backtest' on the detailed report, it will take you back to programming of our backtest

Now we will create the optimization, change the sell short figure from 37 to 'number' as seen in figure 25.

Change this from 37 to number so that optimization conditions can be defined for 'number'

REM Short

```
Indicator1 = Chandle[20](close)
c1 = (Indicator1 >= number)
```

```
IF c1 THEN
    SELLSHORT 100000 SHARES AT MARKET THISBARONCLOSE
ENDIF
```

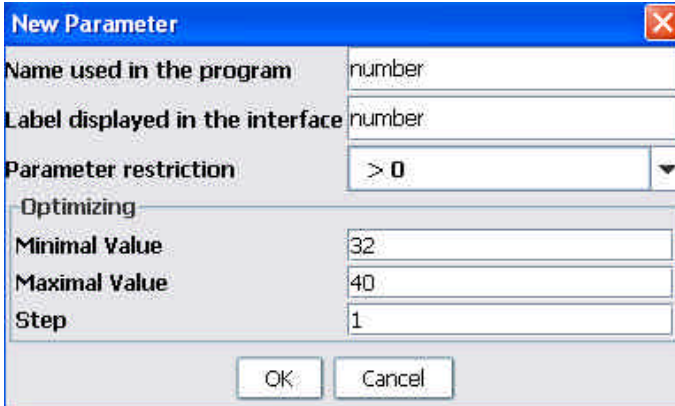
REM Exit short

```
Indicator2 = Chandle[20](close)
c2 = (Indicator2 <= -37.0)
```

```
IF c2 THEN
    EXITSHORT AT MARKET THISBARONCLOSE
ENDIF
```

Figure 25: conditions redefined to enter our short

- Under the optimization parameters section shown in figure 20. Click on add and fill in the fields like figure 26, so that we have a range for our entrance trade from 32 to 40 with increments of 1



The 'New Parameter' dialog box is shown with the following fields:

Name used in the program	number
Label displayed in the interface	number
Parameter restriction	> 0
Optimizing	
Minimal Value	32
Maximal Value	40
Step	1

Buttons: OK, Cancel

Figure 26: defining the optimization

- Click ok and then validate the program again. The below results (figures 27-31) are now produced

Detailed Report: cable

Summary Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	8283.92	0.00	8283.92
Gross Profit	8283.92	0.00	8283.92
Gross Loss	0.00	0.00	0.00
Profit Factor	n/a	n/a	n/a
Total Number of Trades	4	0	4
Percent Profitable	75.00%	n/a	75.00%
Winning Trades	3	0	3
Losing Trades	0	0	0
Even Trades	1	0	1
Avg Trade Net Profit	2070.98	n/a	2070.98
Avg Winning Trade	2761.31	n/a	2761.31
Avg Losing Trade	n/a	n/a	n/a
Std Deviation of Trade Profit	1248.15	n/a	1248.15
Largest Winning Trade	3109.89	0.00	3109.89
Largest Losing Trade	0.00	0.00	0.00
Avg Bars in Trades	17.75	n/a	17.75
Avg Bars Between Trades	52.33	n/a	52.33
Avg Bars in Winning Trades	23.67	n/a	23.67
Avg Bars in Losing Trades	n/a	n/a	n/a
Avg Bars in Even Trades	0.00	n/a	0.00
Percent of Time in the Market	31.14%	31.14%	31.14%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	0	0	0
Max Consecutive Losing Trades	0	0	0
Max draw down	3387.90	0.00	3387.90
Max equity run up	8346.21	0.00	8346.20
Return on initial capital	8.28%	0.00%	8.28%

Modify Backtest Close

Figure 27: optimization statistics shown in the detailed report

 Detailed Report: cable
 



Statistics 
 Trades List 

Date	Buy/Sell	Price	Qty	Current Value	Commission
4 May 2005	Sell (Enter)	1.0514	59487	100282.8359	-
4 May 2005	Buy (Exit)	1.0514	58487	100282.6359	-
25 Sep 2005	Buy (Exit)	1.7730	58614	103922.6250	-
31 Aug 2005	Sell (Enter)	1.8102	58614	106103.0625	-
12 May 2005	Buy (Exit)	1.8628	53745	100136.1875	-
20 Apr 2005	Sell (Enter)	1.9185	53745	103109.7812	-
28 Mar 2005	Buy (Exit)	1.8662	53918	96580.9572	-
11 Mar 2005	Sell (Enter)	1.9261	53918	99999.2578	-

Modify Backtest 
 Close 

Figure 28: optimization orders list

Detailed Report: cable

Statistics Order list

Entry Date	Exit Date	Type	Bars Mo	ABS Prof	Test Prof	Commission
4 May 2006	4 May 2006	Short	0	-	-	-
11 Aug 2005	25 Sep 2005	Short	38	2180.4375	-2.0991	-
20 Apr 2005	12 May 2005	Short	19	2993.5932	-2.9901	-
11 Mar 2005	28 Mar 2005	Short	14	3109.9905	-3.2097	-

Modify Backtest Close

Figure 29: optimization trades list with direction

From the optimisation we still have the same number of trades as four. However our third trade was executed at a better price to short on 11 Aug at 1.8102 rather than 10 Aug at 1.7966, which in turn has increased our profits from a return of 7.5% to 8.28%

The optimisation report in figure 30 shows us our profits at different optimisation parameter points that we defined earlier between 32 to 40 in order of the most profitable condition.

Optimize Report						
Net Profits	Return on Capit	Max Draw Dow	Nb Orders	% Winning Tra	Expectation	number
8283.91	+8.28%	3387.90	4	75.00%	n/a	38
7497.21	+7.50%	3413.48	4	75.00%	n/a	36
7497.21	+7.50%	3413.48	4	75.00%	n/a	37
7396.64	+7.40%	3410.31	4	75.00%	n/a	32
7396.64	+7.40%	3410.31	4	75.00%	n/a	33
7396.64	+7.40%	3410.31	4	75.00%	n/a	34
7396.64	+7.40%	3410.31	4	75.00%	n/a	35
5017.98	+5.02%	3285.70	3	66.67%	n/a	39
5017.98	+5.02%	3285.70	3	66.67%	n/a	40

Figure 30: detailed optimization report



Figure 31: chart displaying the optimized backtest

CREATION BY PROGRAMMING

ProRealTime provide some modules and manuals to assist you in creating backtests. You can access this from either www.prorealtime.com/en or by clicking the 'ProBacktestHelp' as seen in figure 20.

This following section uses some of the information provided from prorealtime and simplifies it. Having gone through the assisted creation this section should be easier to understand.

Order Definition

As in the assisted creation we define our conditions for our order.

Long positions

BUY *count* **SHARES** (AT MARKET | AT *price* LIMIT | AT *price* STOP)

A long position will be opened using this command. If you were already short prior to this, the short will be closed and the position bought would put you long by the *count* of shares stated. If you were already long prior to this execution then this command would depend on conditions stated within capital management.

SELL *count* **SHARES** (AT MARKET | AT *price* LIMIT | AT *price* STOP)

Long positions will be sold using this command. If the positions are flat or short then nothing will happen. If the backtest is long the *count* shares are sold, if the number is greater than the long position then the position does not go short, if no *count* is used all the position is sold.

Short positions

SELLSHORT *count* **SHARES** (AT MARKET | AT *price* LIMIT | AT *price* STOP)

This command opens a short position. If the position is already long, then it is reversed to be short by the count. If you were already short prior to this execution then this command would depend on conditions stated within capital management.

EXITSHORT *count* SHARES (AT MARKET | AT *price* LIMIT | AT *price* STOP)

A short position is closed with this command. If the position is flat or long then nothing happens. If the position is short then the *count* shares are bought, if *count* was greater than the short positions, a long position is not opened but the position will be flattened; if no *count* is used all the position is bought.

An example of the use of these commands as market, limit and stop is shown in figure 32.



Figure 32: shows an example of commands used to program orders

Quantity

There are a number of alternatives that can be used instead of defining the quantity as the number of shares:

SHARES	number of shares
CASH	
	amount of cash units
%CAPITAL	percentage of the current capital
%LIQUIDITY	percentage of the current available cash

Examples of these commands are given below in figure 33.

REM Buy 10000USD worth of stock

BUY 10000 Cash AT MARKET

REM Buy using 50% of the current capital when dow chemical is 30,50
current = 39,84

BUY 50 %Capital AT 30.50 LIMIT

REM Buy using 20% of available cash when dow chemical is 45,12

BUY 20 %Liquidity AT 45.12 STOP

REM all trades that exit like sell and exitshort you do not need to enter the
count

SELL AT MARKET

Figure 33: commands used to set quantities

Date of execution

If not instructed orders are executed on the next bar; however market orders can be executed before or after this bar using the following commands.

ThisBarOnClose	at the close of the current bar
NextBarOpen	at the open of the next bar (default order)
NextBarClose	at the close of the next bar
TodayOnClose	at the close of the current day
TomorrowOpen	at the open of the day after
TomorrowClose	at the close of the day after

An example can be seen in figure 34 below.

REM all you have to do is enter one of the 'date of execution' commands after the word MARKET

BUY 10000 Shares AT MARKET ThisBarOnClose

This can be upper or lower case or a combination does not matter

Figure 34: use of when to execute commands

Price Terms

These terms are technical analysis basics; used to emphasize certain aspects. For example when calculating a moving average it can be based on the open and close or a formula derived upon the high, low and close, as in figure 37, the weighted moving average is calculated on the closing price or periods to the prior 30days.

The terms that can be used with there definitions are:

Open	Opening price of the current bar
High	Highest price of the current bar
Low	Lowest price of the current bar
Close	Closing price of the current bar
OpenOfNextBar	Opening price of the next bar

Time Frames

You can also use other time frames for your program, see below for the list of functions and descriptions.

Minute	Minute of the close of the current bar
Hour	Hour of the close of the current bar
Day	Day of the close of the current bar
Month	Month of the close of the current bar
Year	Year of the close of the current bar
DayOfWeek	Day of Week of the close of the current bar (where Monday = 1, Tuesday = 2 etc.)

An example of the use of time frames is given in figure 38.

MIN/MAX

This mathematic function will return the lowest and the highest of two elements; you need to use the below convention. An example of its use is given in figure 50.

MIN (a, b) where a and b are two defined conditions or quantities e.g.
MAX (a, b) MAX(open, close)

Control Structures

A control structure can be created using the below commands, where you can extend or simplify the else/elsif conditions as you require, a simple example is given in figure 37.

```
IF test1 THEN
                                Instructions 1
ELSIF test2 THEN
                                Instructions 2
ELSE
                                Instructions 3
ENDIF
```

End of the
program

```
REM use of a simple control structure
IF close > WeightedAverage[30](close) THEN
    BUY 10000 Shares AT MARKET
ENDIF
```

Translation of program –

If the close is greater than the
close of a 30 period weighted
moving average

Then buy 10000 shares at
market price

Figure 37: example of the use of a simple control structure

Lets look at another example. Many traders know through historical data that markets tend to rise around October till late April and then fall from May till September. Lets see what happens if we short UK100 in May and buy in October investing 60% of our capital, over five years. Figure 38 shows the program used in this example on the 5-year daily chart.

REM Sell short in May

IF Month = 5 THEN

SELLSHORT 60 %Capital AT MARKET

REM Buy to close in October

ELSIF Month = 10 THEN

Buy 60 %Capital AT MARKET

ENDIF

Translation of program –

If the month is May then go short 60% of the available capital at market price

Else if the month is October then buy 60% of the capital at market price

Figure 38: program used to sell short in May and go long in October

From figures 39 and 40 it can be seen that this is a good strategy.

Detailed Report: UK100

Statistics Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	2832.11	1243.24	1588.88
Gross Profit	4036.67	1264.05	2772.62
Gross Loss	-1204.55	-20.81	-1183.74
Profit Factor	3.35	60.74	2.34
Total Number of Trades	11	5	6
Percent Profitable	63.64%	80.00%	50.00%
Winning Trades	7	4	3
Losing Trades	4	1	3
Even Trades	0	0	0
Avg Trade Net Profit	257.46	248.65	264.81
Avg Winning Trade	576.67	316.01	924.21
Avg Losing Trade	-301.14	-20.81	-394.58
Std Deviation of Trade Profit	548.69	179.06	724.65
Largest Winning Trade	1237.16	493.00	1237.16
Largest Losing Trade	-687.99	-20.81	-687.99
Avg Bars in Trades	120.00	151.60	93.67
Avg Bars Between Trades	8.50	21.25	17.00
Avg Bars in Winning Trades	120.00	151.50	78.00
Avg Bars in Losing Trades	120.00	152.00	109.33
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	93.95%	93.95%	93.95%
Total Commission	100.89	48.76	52.12
Max Consecutive Winning Trades	5	1	2
Max Consecutive Losing Trades	3	1	3
Max draw down	1458.18	896.00	1668.02
Max equity run up	3048.24	1431.82	2663.07
Return on initial capital	28.32%	12.43%	15.89%

Modify Backtest Close

Figure 39: Detailed statistics report showing a healthy 28% return

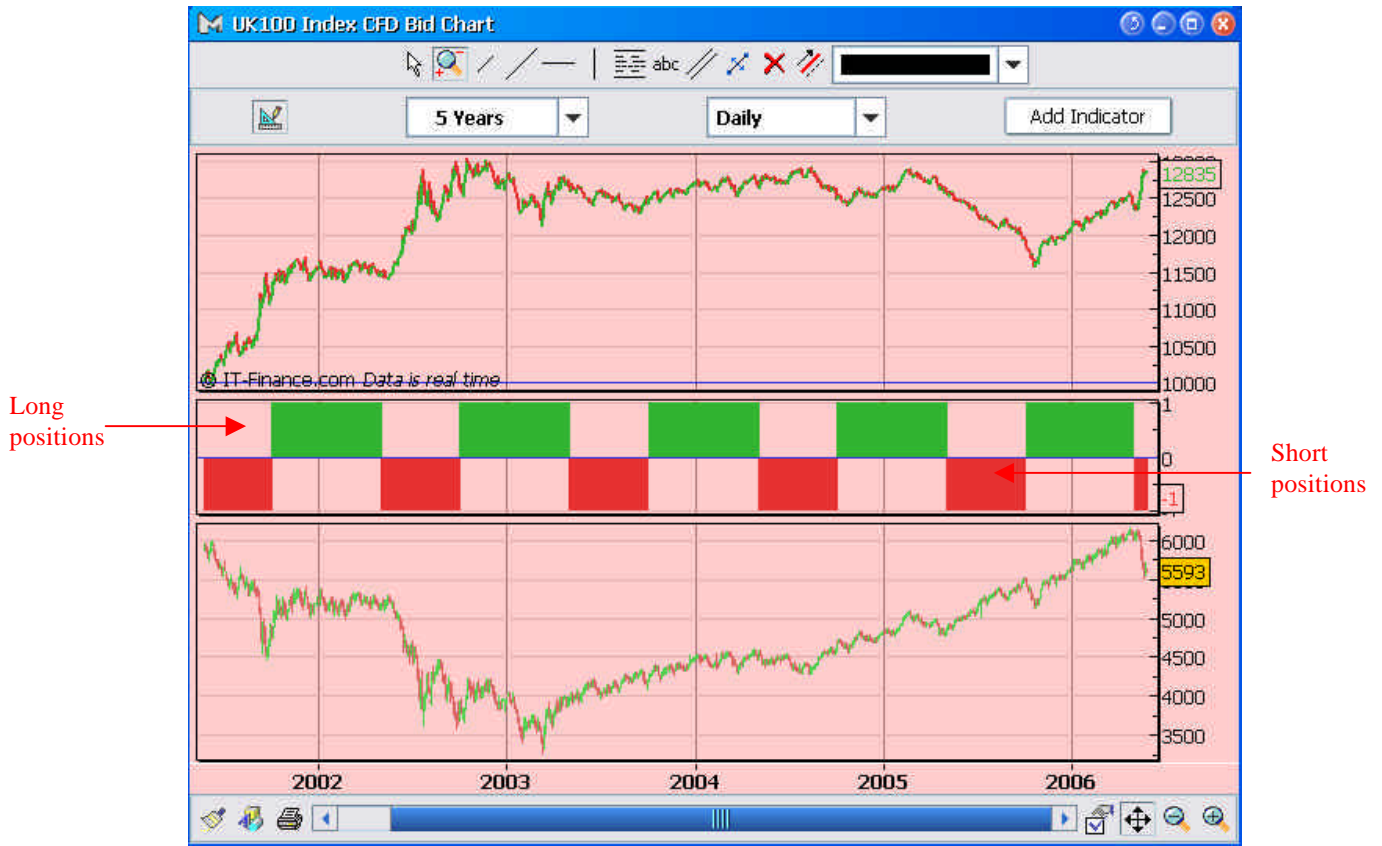


Figure 40: chart showing our backtest

Test yourself

Try and create a similar program yourself, on the same 5year/daily UK100 chart, so that we go long in month 10, sell out month 1, then go long again in month 2 and close out in month 5. We will invest 100% of our capital

Turn over and look at figure 40 if you struggle, figure 41 gives the results of this strategy.

REM go long in month 10 and sell in month 1 and then again in Month 2 sell in month 5

IF Month = 10 THEN

BUY 100%capital AT MARKET

ELSIF Month = 1 THEN

SELL AT MARKET

ENDIF

IF Month = 2 THEN

BUY 100%capital AT MARKET

ELSIF Month = 5 THEN

SELL AT MARKET

ENDIF

Translation of program –

If its Oct then buy 100% of our capital at market price, else if it's Jan then sell at market price

If it's Feb then buy 100% of our capital at market price, else if its May then sell at market price

Figure 40: program showing 2 longs from Oct to Jan and then Feb to May

■ Detailed Report: UK100

Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	2322.81	2322.81	0.00
Gross Profit	2865.12	2865.12	0.00
Gross Loss	-542.31	-542.31	0.00
Profit Factor	5.28	5.28	n/a
Total Number of Trades	11	11	0
Percent Profitable	72.73%	72.73%	n/a
Winning Trades	8	8	0
Losing Trades	3	3	0
Even Trades	0	0	0
Avg Trade Net Profit	211.16	211.16	n/a
Avg Winning Trade	358.14	358.14	n/a
Avg Losing Trade	-180.77	-180.77	n/a
Std Deviation of Trade Profit	200.74	200.74	n/a
Largest Winning Trade	700.08	700.08	0.00
Largest Losing Trade	-318.20	-318.20	0.00
Avg Bars in Trades	64.45	64.45	n/a
Avg Bars Between Trades	69.70	69.70	n/a
Avg Bars in Winning Trades	65.00	65.00	n/a
Avg Bars in Losing Trades	63.00	63.00	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	50.43%	50.43%	50.43%
Total Commission	203.19	203.19	0.00
Max Consecutive Winning Trades	5	5	0
Max Consecutive Losing Trades	1	1	0
Max draw down	1258.63	1258.63	0.00
Max equity run up	3547.07	3547.07	0.00
Return on initial capital	23.23%	23.23%	0.00%

Modify Backtest Close

Figure 41: detailed statistics for the backtest showing a good profitable strategy

Insert Function

As shown in figure 20 under the creation by programming tab there is a 'insert function' button. This brings up a window with all the available functions, which are categorized including the ones that you create, as seen below in figure 42. It also provides help with more information about a chosen function.

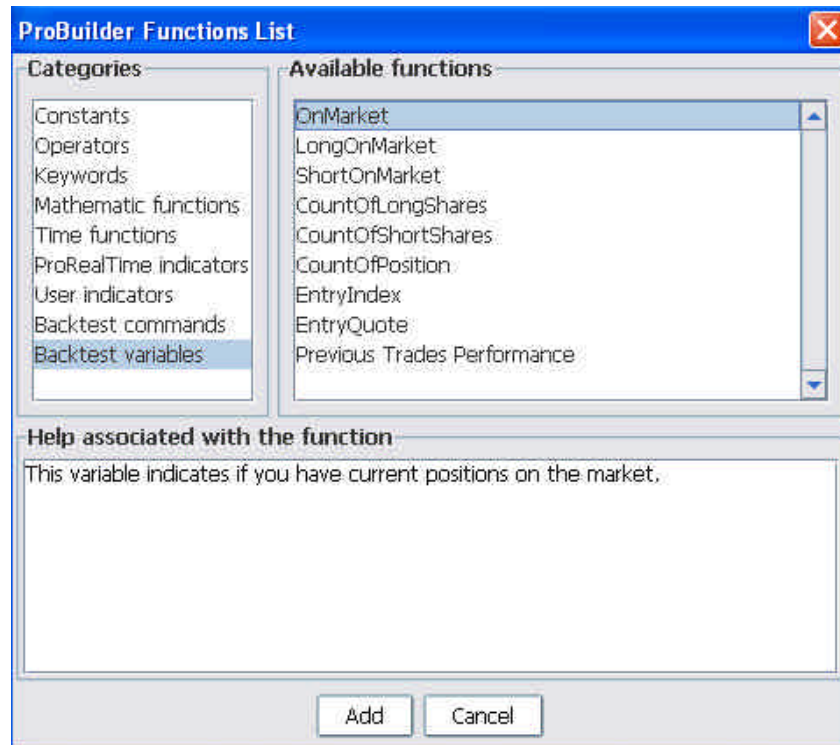


Figure 42: functions list available from the insert function button

State Variables

The three possible variables are: **OnMarket**, **LongOnMarket** and **ShortOnMarket** refer to being flat, long or short. Hence this function allows you to know the state of your backtest portfolio.

The importance of this is associated with knowing your position's direction. As the reasons why you want to execute orders will not always be the same. Different results are produced dependent on being long, short or flat. E.g. the exit of a long and an uncovered sell are two different strategies, hence the former is a position closed and the latter is being opened.

Examples on the use of this order are given in figures 43 and 44.

Logical Operators

The operators described below are used to implement combinations of comparisons.

NOT (a)	Logical NOT
a OR b	Logical OR
a AND b	Logical AND
a XOR b	Logical Exclusive OR

An example of the use of these functions is given in figures 43 and 44.

AS

Commands and variables are linked to one or more strategies. If you do not define your strategy, the backtest will create one strategy and all commands are then linked to it. There is no limit to the number of strategies you can create.

The keyword **AS** is used to classify several strategies within the same program. Hence you use this function so that the instructions only apply to this strategy. An example is provided below in figure 43.

```
REM use of the term AS in a backtest strategy

IF close > AVERAGE[50](close) AND NOT OnMarket THEN
    BUY 50 %Liquidity AT MARKET AS "moving average"
ENDIF

REM sell on the breakout of the low of the entry bar
IF close < low[BarIndex - EntryIndex AS "moving average"] THEN
    SELL AT MARKET AS "moving average"
ENDIF
```

Translation of program –

If the closing price is greater than moving average based on 50 period closing price and you have no positions then buy 50% of the available cash at market price for our strategy 'moving average'

If the closing price is less than the low calculated as the current bar minus the bar, which the latest order was

Figure 43: the use of the function AS in a backtest

Variables of Position Following

These variables give more precise information on the state variables. They will tell you whether you have positions currently and if so how many.

The three variables are:

CountOfLongShares the count of shares in a long position (0 if not long)

CountOfShortShares the count of shares in a short position (0 if not short)

CountOfPosition the count of accumulated positions (if pyramid is allowed)

Figure 44 below shows an example of the use of variables. The program buys 10000 shares or quantity in this case on the EURUSD spot when the price breaks out from the 20day moving average. If the conditions are met then the program continues to buy up to 3 times and sells the position on a new low breakout.

```
REM buy when the price breaks out of the 20day moving average
condition1 = close > AVERAGE[20](close)
```

Translation of program –

```
REM this condition is to enter the market
IF NOT OnMarket THEN
  IF condition1 THEN
    BUY 10000 Shares AT MARKET
  ENDIF
ENDIF
```

Condition1 is the closing price has to be greater than the 20-day moving average based on closing price

If there are no positions then if condition1 is met buy 10000 at market price

```
REM if the buy condition is true pyramid the position 3 times
IF OnMarket THEN
```

If there is a position then condition2 is when the closing price is less than the lowest calculated moving low price of the indicator where we refer to 15bars on indicator1

```
  REM condition 2 is given by a new low breakout
  condition2 = close < LOWEST [15](low[1])
```

Lowest [count bars](indicator)

```
  REM the exit depends on a double condition
```

```
  IF NOT condition1 or condition2 THEN
    SELL CountOfLongShares Shares AT MARKET
```

If neither condition is being met then sell all the shares at market

```
  REM pyramids 3 times while the exit condition is false
```

```
  ELSIF CountOfPosition < 3 THEN
```

Else if the position is less than 3 then buy 10000 at market price

```
    BUY 10000 Shares AT MARKET
```

```
  ENDIF
```

```
ENDIF
```

Figure 44: use of variables example on EURUSD

The use of pyramids is only permitted if the option 'accumulate positions' is ticked in the capital management window as seen in figure 5 under the section positions management.

Also if you use 1 stop for all positions then all positions will be merged into one so the count cannot be greater than one.

Figures 45-48 show our results as not a profitable strategy.

Detailed Report: EURUSD

Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	-59.00	-59.00	0.00
Gross Profit	3041.00	3041.00	0.00
Gross Loss	-3094.00	-3094.00	0.00
Profit Factor	0.08	0.08	n/a
Total Number of Trades	30	30	0
Percent Profitable	23.33%	23.33%	n/a
Winning Trades	7	7	0
Losing Trades	23	23	0
Even Trades	0	0	0
Avg Trade Net Profit	-1.77	-1.77	n/a
Avg Winning Trade	434.43	434.43	n/a
Avg Losing Trade	-134.52	-134.52	n/a
Std Deviation of Trade Profit	405.45	405.45	n/a
Largest Winning Trade	1948.00	1948.00	0.00
Largest Losing Trade	-464.00	-464.00	0.00
Avg Bars in Trades	6.20	6.20	n/a
Avg Bars Between Trades	8.28	8.28	n/a
Avg Bars in Winning Trades	17.71	17.71	n/a
Avg Bars in Losing Trades	3.35	3.35	n/a
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	45.56%	45.56%	45.56%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	1	1	0
Max Consecutive Losing Trades	8	8	0
Max draw down	2059.00	2059.00	0.00
Max equity run up	2513.01	2513.01	0.00
Return on Initial Capital	-0.05%	-0.05%	0.00%

Modify Backtest Close

Figure 45: shows the detailed report statistics

■ Detailed Report: EURUSD

Statistics Orders Trades List

Date	Buy/Sell	Price	Qty	Current Value	Commission
30 Aug 2005	Sell (Exit)	1.2221	10000	12221.0000	-
29 Aug 2005	Buy (Enter)	1.2339	10000	12339.9990	-
18 Aug 2005	Sell (Exit)	1.2200	30000	36798.0000	-
31 Jul 2005	Buy (Enter)	1.2130	10000	12130.0010	-
29 Jul 2005	Buy (Enter)	1.2127	10000	12127.0000	-
29 Jul 2005	Buy (Enter)	1.2069	10000	12069.0000	-
27 Jul 2005	Sell (Exit)	1.2019	30000	36094.0000	-
20 Jul 2005	Buy (Enter)	1.2029	10000	12029.0000	-
19 Jul 2005	Buy (Enter)	1.2062	10000	12062.0000	-
18 Jul 2005	Buy (Enter)	1.2046	10000	12046.0000	-
17 Jul 2005	Sell (Exit)	1.2080	30000	36108.0000	-
14 Jul 2005	Buy (Enter)	1.2078	10000	12078.0000	-
13 Jul 2005	Buy (Enter)	1.2217	10000	12217.0000	-
12 Jul 2005	Buy (Enter)	1.2067	10000	12067.0000	-
29 Jun 2005	Sell (Exit)	1.2070	10000	12070.0000	-
28 Jun 2005	Buy (Enter)	1.2166	10000	12166.9990	-
20 Jun 2005	Sell (Exit)	1.2212	10000	12212.0000	-
19 Jun 2005	Buy (Enter)	1.2247	10000	12247.0000	-
28 Apr 2005	Sell (Exit)	1.2925	30000	38775.0000	-
19 Apr 2005	Buy (Enter)	1.3011	10000	13011.0000	-
18 Apr 2005	Buy (Enter)	1.2914	10000	12914.0000	-
17 Apr 2005	Buy (Enter)	1.2910	10000	12910.0000	-
13 Apr 2005	Sell (Exit)	1.2904	10000	12904.0000	-
12 Apr 2005	Buy (Enter)	1.2979	10000	12979.0000	-
22 Mar 2005	Sell (Exit)	1.3157	30000	39471.0000	-
17 Feb 2005	Buy (Enter)	1.3029	10000	13029.0000	-
16 Feb 2005	Buy (Enter)	1.3011	10000	13011.0000	-
15 Feb 2005	Buy (Enter)	1.2970	10000	12970.0010	-

Modify Backtest Close

Figure 46: above is the orders list where the quantities can also be seen to be accumulating

Detailed Report: EURUSD

Statistics Orders list

Entry Date	Exit Date	Type	Bar No	Abs Profit	Relat Profit	Commission
26 May 2005	28 May 2005	Long	1	-70.0000	-0.5486	-
14 Apr 2005	25 May 2005	Long	35	1948.0000	5.3586	-
12 Apr 2005	13 Apr 2005	Long	1	-83.0000	-0.4960	-
30 Mar 2005	9 Apr 2005	Long	8	9.0000	0.0248	-
26 Mar 2005	28 Mar 2005	Long	2	-44.0000	-0.1828	-
14 Mar 2005	24 Mar 2005	Long	9	-149.0000	-0.3967	-
1 Mar 2005	8 Mar 2005	Long	6	-220.0000	-0.6131	-
1 Feb 2005	2 Feb 2005	Long	1	-81.9990	-0.6751	-
4 Jan 2005	29 Jan 2005	Long	21	70.0000	0.1931	-
28 Dec 2005	26 Dec 2005	Long	2	-17.0000	-0.0716	-
9 Dec 2005	22 Dec 2005	Long	11	70.0000	0.1976	-
6 Dec 2005	8 Dec 2005	Long	2	-149.0000	-0.5319	-
29 Nov 2005	2 Dec 2005	Long	3	-187.0000	-0.5281	-
27 Nov 2005	28 Nov 2005	Long	1	4.0000	0.0342	-
23 Nov 2005	25 Nov 2005	Long	2	-6.0020	-0.0254	-
3 Nov 2005	4 Nov 2005	Long	1	-117.9990	-0.5779	-
26 Oct 2005	1 Nov 2005	Long	5	-335.0000	-0.9231	-
21 Oct 2005	23 Oct 2005	Long	1	-88.9990	-0.7394	-
16 Oct 2005	18 Oct 2005	Long	2	-129.0000	-0.5345	-
7 Oct 2005	11 Oct 2005	Long	3	-258.0000	-0.7361	-
1 Sep 2005	13 Sep 2005	Long	10	-464.0000	-1.2424	-
29 Aug 2005	30 Aug 2005	Long	1	-117.9990	-0.5568	-
28 Jul 2005	18 Aug 2005	Long	18	473.0000	1.3021	-
18 Jul 2005	27 Jul 2005	Long	8	-82.0000	-0.2289	-
12 Jul 2005	17 Jul 2005	Long	4	-254.0000	-0.6985	-
28 Jun 2005	29 Jun 2005	Long	1	-55.9990	-0.7801	-
19 Jun 2005	20 Jun 2005	Long	1	-35.0000	-0.2858	-
17 Apr 2005	28 Apr 2005	Long	10	-60.0000	-0.1545	-

Modify Backtest Close

Figure 47: the backtest trades list all the positions were long

Shows the
accumulation of
the position



Figure 48: the EURUSD chart showing our backtest results

Bars Access Relative to the Last Executed Order

There are two types of commands. **EntryIndex**, which is the index of the bar on which the latest order, was executed and **EntryQuote** gives the price of the last order.

Another commonly used command is **BarIndex**, which is the index of the current bar in the chart (from 0).

An example is provided below in figure 49.

REM buy on a moving average breakout:

```
IF NOT OnMarket THEN
    IF close > ExponentialAverage[20](close) THEN
        BUY 10000 Shares AT MARKET
    ENDIF
ENDIF
```

Translation of program –

If there are no positions then if the closing price is greater than the 20-day exponential moving average calculated based on the closing price then buy 10000 shares at market price

REM exit under the lowest price of the candlestick entry

```
IF OnMarket THEN
    SELL AT low[BarIndex - EntryIndex] STOP
ENDIF
```

If there is an open position then, stop sell at the low given by the current bar minus the last order bar

You could use EntryQuote here, e.g. to exit under the market price SELL AT EntryQuote STOP

Figure 49: an example of the use of bar access relative to the last executed orders

Stop loss programming

You can add four different types of stops as seen in the assisted creation on pages 13 and 14.

The function **SET STOP price** allows you to create a customized stop. An example of this is shown in figure 50.

Translation of program –

If the closing price is greater the moving average based on the closing price of 20 days and you have no positions then buy 10000 shares at market price

REM a following STOP

```
IF close > AVERAGE[20] AND NOT OnMarket THEN
  BUY 10000 Shares AT MARKET
```

You can create your own names to these as long as they are referenced the same throughout the program

REM calculate the difference between ideal price and real price
Spread = openOfNextBar - low

REM initialize the highest price since the market execution:
Up = openOfNextBar
ENDIF

REM updates the stop to let its distance to the highest price constant

```
IF OnMarket THEN
  Up = MAX(Up, high)
  SET STOP (Up - Spread)
ENDIF
```

MAX returns the higher of two elements

Figure 50: showing an example program of a stop

Test Yourself

Lets end with a test, looking at a UK pharmaceutical stock Glaxo Smith Kline (GSK) daily chart for a year. We want to create a backtest by programming using the Average True Range (ATR) so that we buy or sellshort when there is a panic in the market.

ATR is simply a moving average of true range calculated over a number of days. True Range and Average True Range are common volatility measurements. The larger the True Range, the greater the volatility of the stock.

Conditions for long positions

We want to buy at market price investing all our capital when the closing price of GSK is greater than the previous days close + the AVT based on the closing price of 30days.

Conditions for short positions

We want to sellshort at market price investing a third of our capital when the closing price of GSK is less than the previous days close - the AVT based on the closing price of 30days.

Then optimize the program to find the optimum AVT value testing from 20-40days with increments of 1.

(Turn the page to view figures 51-61 for help and the results)

Note: We will always hold a position, as it will reverse itself. We are using only a third of our capital on shorts as with short positions the potential loss is unlimited.

REM strong increase in prices = panic buy hence buy when:

```
IF close > close[1] + AverageTrueRange[30](close) THEN
    BUY 100%Capital AT MARKET
ENDIF
```

REM strong decrease of prices = panic selling hence sell when:

```
IF close < close[1] - AverageTrueRange[30](close) THEN
    SELLSHORT 33%Capital AT MARKET
ENDIF
```

Translation of program –

If the close is greater than the previous days close + the AVT based on the 30day closing price then buy 100% of the capital at market price

If the close is less than

Figure 51: the code required to generate this program

Detailed Report: GSK

Parameters Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	-165.25	4247.25	-4412.50
Gross Profit	19876.00	19151.00	725.00
Gross Loss	-20041.25	-14903.75	-5137.50
Profit Factor	0.99	1.28	0.14
Total Number of Trades	12	6	6
Percent Profitable	25.00%	33.33%	16.67%
Winning Trades	3	2	1
Losing Trades	9	4	5
Even Trades	0	0	0
Avg Trade Net Profit	-13.77	707.88	-735.42
Avg Winning Trade	6625.33	9575.50	725.00
Avg Losing Trade	-2226.81	-3725.94	-1027.50
Std Deviation of Trade Profit	4964.02	6872.77	1003.21
Largest Winning Trade	14040.00	14040.00	725.00
Largest Losing Trade	-5865.00	-5865.00	-2528.50
Avg Bars in Trades	33.92	49.83	18.00
Avg Bars Between Trades	4.00	8.80	8.80
Avg Bars in Winning Trades	83.00	94.50	60.00
Avg Bars in Losing Trades	17.56	27.50	9.60
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	90.27%	90.27%	90.27%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	2	2	1
Max Consecutive Losing Trades	5	1	2
Max draw down	18588.50	14329.50	7513.50
Max equity run up	22610.50	23468.50	7752.50
Return on initial capital	-0.17%	4.25%	-4.41%

Modify Backtest Close

Figure 52: detailed statistics report showing a flat strategy

Detailed Report: GSK

Statistics Trades List

Date	↑	Buy/Sell	Price	Qty	Current Value	Commission
31 May 2006		Sell (Enter)	1454.25	92	133791.00	-
9 Mar 2006		Buy (Enter)	1540.50	94	144807.00	-
1 Mar 2006		Sell (Enter)	1443.25	101	145766.25	-
30 Feb 2006		Buy (Enter)	1492.75	101	150767.75	-
31 Jan 2006		Sell (Enter)	1442.00	104	149968.00	-
29 Jan 2006		Buy (Enter)	1468.00	103	151204.00	-
20 Nov 2005		Sell (Enter)	1497.00	101	151197.00	-
28 Oct 2005		Buy (Enter)	1429.75	102	145834.50	-
21 Oct 2005		Sell (Enter)	1411.75	104	146822.00	-
6 Apr 2005		Buy (Enter)	1231.75	104	128102.00	-
20 Mar 2005		Sell (Enter)	1223.00	105	128415.00	-
22 Feb 2005		Buy (Enter)	1264.75	70	90015.25	-

Modify Backtest Close

Figure 53: the orders list for this test

Detailed Report: GSK

Backtest Orders List

Entry Date	Exit Date	Type	Deal No	Abs Perf	Relat Perf	Commission
31 May 2005	12 Jun 2005	Short	11	-666.00	1.87	-
9 Mar 2005	31 May 2005	Long	70	-5865.00	-5.60	-
1 Mar 2005	9 Mar 2005	Short	7	-2526.50	6.31	-
10 Feb 2005	1 Mar 2005	Long	16	-3712.50	-3.32	-
31 Jan 2005	10 Feb 2005	Short	9	-1319.50	3.40	-
20 Jan 2005	31 Jan 2005	Long	2	-2028.00	-1.77	-
20 Nov 2005	29 Jan 2005	Short	60	725.00	-1.99	-
29 Oct 2005	20 Nov 2005	Long	19	5111.00	4.70	-
21 Oct 2005	29 Oct 2005	Short	6	-469.00	1.26	-
6 Apr 2005	21 Oct 2005	Long	170	14040.00	14.61	-
20 Mar 2005	6 Apr 2005	Short	15	-227.50	0.71	-
22 Feb 2005	20 Mar 2005	Long	22	-3298.25	-3.30	-

Modify Backtest Close

Figure 54: trades list including the direction

Only a third of
the capital on
shorts over the
long positions →



Figure 55: chart showing the backtest

To create the optimisation, follow the instructions below:

- If you click on 'modify backtest' on the detailed report, it will take you back to programming of our backtest
- In the code change the `AverageTrueRange[30]` to `AverageTrueRange[number]` both for the buy and sellshort
- Under the optimization parameters section shown in figure 20. Click on add and fill in the fields like figure 56 below, so that we have a range for our ATR from 20 to 40 with increments of 1
- Click ok and then validate the program again. The results figures 57-61 are now produced

New Parameter

Name used in the program: number

Label displayed in the interface: number

Parameter restriction: > 0

Optimizing:

Minimal Value: 20

Maximal Value: 40

Step: 1

OK Cancel

Figure 56: defining the optimisation parameters

Optimize Report						
Net Profits	Return on Capit	Max Draw Down	Nb Orders	% Winning Trad	Expectation	number
16729.25	+16.73%	10917.50	10	50.00%	104.87%	31
16729.25	+16.73%	10917.50	10	50.00%	104.87%	32
16729.25	+16.73%	10917.50	10	50.00%	104.87%	33
16729.25	+16.73%	10917.50	10	50.00%	104.87%	34
16729.25	+16.73%	10917.50	10	50.00%	104.87%	35
16729.25	+16.73%	10917.50	10	50.00%	104.87%	36
16729.25	+16.73%	10917.50	10	50.00%	104.87%	37
16729.25	+16.73%	10917.50	10	50.00%	104.87%	38
16729.25	+16.73%	10917.50	10	50.00%	104.87%	39
16729.25	+16.73%	10917.50	10	50.00%	104.87%	40
6477.75	+6.48%	19789.00	10	30.00%	25.68%	20
6477.75	+6.48%	19789.00	10	30.00%	25.68%	21
6477.75	+6.48%	19789.00	10	30.00%	25.68%	22
6477.75	+6.48%	19789.00	10	30.00%	25.68%	23
6477.75	+6.48%	19789.00	10	30.00%	25.68%	24
6477.75	+6.48%	19789.00	10	30.00%	25.68%	25
6477.75	+6.48%	19789.00	10	30.00%	25.68%	26
5371.50	+5.37%	19641.75	12	33.33%	20.13%	27
5371.50	+5.37%	19641.75	12	33.33%	20.13%	28
5371.50	+5.37%	19641.75	12	33.33%	20.13%	29
-213.25	-0.21%	18588.50	12	25.00%	-0.80%	30

Figure 57: optimisation report for AVT values 20-40 days shows 31 as best

Detailed Report: GSK optimised

Statistics Orders list Trades list

	All Trades	Long Trades	Short Trades
Total Net Profit	16645.25	17101.50	-456.25
Gross Profit	24705.75	22404.00	2301.75
Gross Loss	-8060.50	-5302.50	-2758.00
Profit Factor	3.07	4.23	0.83
Total Number of Trades	10	5	5
Percent Profitable	50.00%	60.00%	40.00%
Winning Trades	5	3	2
Losing Trades	5	2	3
Even Trades	0	0	0
Avg Trade Net Profit	1664.53	3420.30	-91.25
Avg Winning Trade	4941.15	7468.00	1150.88
Avg Losing Trade	-1612.10	-2651.25	-919.33
Std Deviation of Trade Profit	5043.17	6597.93	1081.22
Largest Winning Trade	15120.00	15120.00	1518.75
Largest Losing Trade	-3118.50	-3118.50	-1421.00
Avg Bars in Trades	40.70	58.80	22.60
Avg Bars Between Trades	4.89	11.00	11.00
Avg Bars in Winning Trades	57.20	66.33	43.50
Avg Bars in Losing Trades	24.20	47.50	8.67
Avg Bars in Even Trades	n/a	n/a	n/a
Percent of Time in the Market	90.27%	90.27%	90.27%
Total Commission	0.00	0.00	0.00
Max Consecutive Winning Trades	3	3	1
Max Consecutive Losing Trades	2	0	1
Max draw down	10917.50	10056.50	6358.00
Max equity run up	29069.50	30018.50	8719.50
Return on initial capital	16.65%	17.10%	-0.46%

Modify Backtest Close

Figure 58: the optimised detailed report statistics

Detailed Report: GSX optimised

Statistics TradeList

Date	Buy/Sell	Price	Qty	Current Value	Commission
21 May 2006	Sell (Enter)	1454.25	109	159512.25	-
10 Feb 2006	Buy (Enter)	1492.75	109	162709.75	-
21 Jan 2006	Sell (Enter)	1442.00	112	161504.00	-
29 Jan 2006	Buy (Enter)	1468.00	111	162948.00	-
20 Nov 2005	Sell (Enter)	1497.00	109	161676.00	-
28 Oct 2005	Buy (Enter)	1429.75	109	155842.75	-
21 Oct 2005	Sell (Enter)	1411.75	112	159116.00	-
6 Apr 2005	Buy (Enter)	1231.75	111	136724.25	-
6 Mar 2005	Sell (Enter)	1289.00	106	136529.00	-
22 Feb 2005	Buy (Enter)	1264.75	79	99915.25	-

Modify Backtest Close

Figure 59: optimised orders list based on ATR of 31 days

Detailed Report: GSK optimised

Statistics: Orders list:

Entry Date	Exit Date	Type	Bars Mo	Abs Perf	Relat Perf	Commission
31 May 2006	12 Jun 2006	Short	11	-749.00	1.81	-
10 Feb 2006	31 May 2006	Long	93	-3118.50	-2.50	-
31 Jan 2006	10 Feb 2006	Short	9	-1421.00	3.40	-
29 Jan 2006	21 Jan 2006	Long	2	-2184.00	-1.77	-
20 Nov 2005	20 Jan 2006	Short	60	783.00	-1.98	-
28 Oct 2005	20 Nov 2005	Long	19	5447.25	4.70	-
21 Oct 2005	28 Oct 2005	Short	6	-504.00	1.30	-
6 Apr 2005	21 Oct 2005	Long	170	15120.00	14.61	-
6 Mar 2005	6 Apr 2005	Short	27	-1518.75	-4.57	-
22 Feb 2005	6 Mar 2005	Long	10	1836.75	1.84	-

Modify Backtest Close

Figure 60: optimized trades list



Figure 61: optimised graphical representation

This strategy from being barely breakeven has been turned around using the optimisation of the indicator by 16% excluding gearing. This goes to show how valuable or powerful backtesting can be.